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High sensitivity thermal lens microscopy: Cr-VI trace detection in water

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Abstract

In this work, a low detection limit for hexavalent chromium in water of parts per trillions (21 ng/L) was achieved using a micro-spatial thermal lens spectroscopy setup with coaxial counter-propagating pump and probe laser beams and an integrated passive optical Fabry-Perot resonator, aided with a well-established diphenyl carbazide colorimetric method. Cr-VI concentrations in the range of μg/L, i.e. well-below the toxicity thresholds in humans and animals (26 and 190 mg/L respectively) and below those delimited by international regulations for drink water (~0.05-0.5 mg/L), have been obtained by measurements in bottled and tap water samples. The developed thermal lens microscope is also capable to detect Cr-VI directly in potassium dichromate solutions using pump beam wavelengths within the very low optical absorption region in the visible part of the spectrum, i.e., without the use of any colorimetric method.

Key words: photothermal, thermal lens effect, spectroscopy, hexavalent chromium, thermal lens microscope